PATENT ABSTRACTS OF JAPAN

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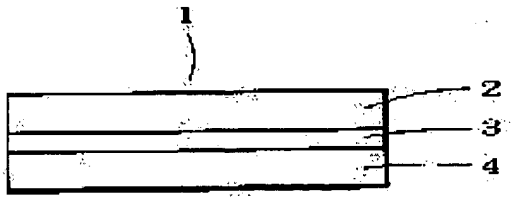
(54) ORIGINAL PLATE FOR VOLUME HOLOGRAM, ITS PRODUCTION AND METHOD FOR DUPLICATION OF VOLUME HOLOGRAM USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To eliminate the defect of an easy tendency of an original plate to damage at the time of the mass duplication by laminating a volume hologram- forming resin composition layer between two transparent substrates.

SOLUTION: The resin layer recorded with a volume hologram is laminated between the two transparent substrates. For example, non-alkali glass or quartz or transparent plastics, such as polyethylene terephthalate resins or acrylic resins, having the refractive index approximate to the refractive index of the volume hologram-forming resin layer 3 is used for the transparent substrates 2, 4. The hologram of the hologram layer 3 is preferably called as a volume hologram and is formed by recording the interference light of object light and reference light on a photosensitive material sufficiently thicker than the spacings between the interference frings and the three-dimensional constitution of the interference frings is recorded as it is. The volume hologram is recorded on the volume hologram-forming resin composition layer. The volume hologram- forming resin composition includes known volume hologram-recording materials, such as silver salt material and dichromic acid gelatin emulsion.



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CLAIMS

[Claim(s)]
[Claim 1] A detection means to be the abnormalities / failure preperception equipment about the dynamic element of a work machine, and to detect the dynamic characteristics data of this dynamic element when inputting a stimulus into this dynamic element at the time of un-operating of this dynamic element, A comparison means to compare the secular-change property data for which it asked beforehand with these dynamic characteristics data obtained with this detection means, The abnormalities / failure preperception equipment of the work machine which presumes time until this dynamic element results in abnormalities or failure according to the comparison result in this comparison means, and is characterized by offering the abnormalities / a failure preperception means perform the abnormalities / failure preperception about this dynamic element, and being constituted based on this time.
[Claim 2] Are the abnormalities / the failure preperception technique about the dynamic element of a work machine, and a stimulus is inputted into this dynamic element at the time of un-operating of this dynamic element. The comparison step which compares the detection step which detects the dynamic characteristics data of this dynamic element with the secular-change property data for which it asked beforehand with these dynamic characteristics data obtained at this detection step, According to the comparison result in this comparison step, time until this dynamic element results in abnormalities or failure is presumed. The abnormalities / the failure preperception technique of the work machine characterized by offering the abnormalities / failure preperception step which performs the abnormalities / failure preperception about this dynamic element, and being constituted based on this time.
[Claim 3] It is the abnormalities / the failure preperception technique about the dynamic element of a work machine, and is contingent [on this dynamic element being in non-operating state]. by the necessary time interval The detection step which inputs a stimulus into this dynamic element and detects the dynamic characteristics data of this dynamic element, The storage step which memorizes these dynamic characteristics data obtained at this detection step, The comparison step which compares the secular-change property data for which it asked beforehand with these dynamic characteristics data memorized at this storage step, According to the comparison result in this comparison step, time until this dynamic element results in abnormalities or failure is presumed. The

abnormalities / the failure preperception technique of the work machine characterized by offering the abnormalities / failure preperception step which performs the abnormalities / failure preperception about this dynamic element, and being constituted based on this time.
[Claim 4] This detection step is set at the time of un-operating of this dynamic element. as this stimulus White noise is inputted into this dynamic element, and it is constituted so that the frequency response data at that time may be detected as these dynamic characteristics data. this comparison step It is constituted so that these frequency response data and these secular-change property data which were obtained at this detection step may be compared. this abnormalities / failure preperception step According to the comparison result in this comparison step, time until this dynamic element results in abnormalities or failure is presumed. The abnormalities / the failure preperception technique of the work machine according to claim 2 or 3 characterized by being constituted based on this time so that the abnormalities / failure preperception about this dynamic element may be performed.
[Claim 5] This detection step is set at the time of un-operating of this dynamic element. as this stimulus An impulse signal is inputted into this dynamic element, and it is constituted so that the impulse response data at that time may be detected as these dynamic characteristics data. this comparison step It is constituted so that these impulse response data and these secular-change property data which were obtained at this detection step may be compared. this abnormalities / failure preperception step According to the comparison result in this comparison step, time until this dynamic element results in abnormalities or failure is presumed. The abnormalities / the failure preperception technique of the work machine according to claim 2 or 3 characterized by being constituted based on this time so that the abnormalities / failure preperception about this dynamic element may be performed.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention is used for foreknowing the abnormalities of construction equipments, such as a hydraulic excavator and a bulldozer, and failure about the abnormalities / failure preperception equipment, and technique of a work machine, and relates to abnormalities / suitable failure preperception equipment, and suitable technique.
[0002]
[Description of the Prior Art] Drawing 10 is a ** type view showing an example of the hydraulic excavator as a common work machine, and as shown in this drawing 10 , usually, the hydraulic excavator has offered the revolving super-structure 100 with operation room (cabin) 600 on the base carrier 500 which has infinite rail section 500A, and serves as the configuration of having equipped the joint formula arm device which becomes this revolving super-structure 100 from a boom 200, the stick 300, and the bucket 400 further.

[0003] And while this hydraulic excavator is equipped with the oil hydraulic cylinder 122 for the oil hydraulic cylinder 121 for the oil hydraulic cylinder 120 for a boom 200, and the stick 300, and the bucket 400 The hydraulic circuit for each of these oil hydraulic cylinders 120-122 (illustration abbreviation) is prepared at least. By carrying out electronics control of the flow rate of the hydraulic pump in this hydraulic circuit, or the control valve the oil hydraulic cylinder 120 - for 122 according to operation (operation of the control lever in a cabin 600) of an operator, and changing suitably the amount of supply (oil pressure) of the hydraulic oil to oil hydraulic cylinders 120-122 expansion and contraction of oil hydraulic cylinders 120-122 -- a variation rate -- an amount changes and a boom 200, the stick 300, and the bucket 400 drive, respectively
[0004] By the way, since, as for such a construction equipment, a job site, a calamity restoration site, etc. are usually begun and it is used in many cases in the very severe status, the suitable treatment needs to be performed to the abnormalities and failure. Then, a sensor is conventionally attached in parts (dynamic element) for a right hand side, such as the above-mentioned hydraulic pump, and a control valve, the cylinders 120-122, and the abnormalities of a construction equipment and a diagnosis of failure are performed by comparing and judging whether the electric signal (henceforth a sensor signal) acquired by the sensor is the proper value calculated beforehand.
[0005]
[Problem(s) to be Solved by the Invention] However, it is almost impossible they to perform the abnormalities / failure preperception that probably abnormalities and failure will arise to a dynamic element, in what after term by the conventional troubleshooting technique, even if it can diagnose the abnormalities in the present condition of the dynamic element of a construction equipment (work machine) and failure, and it is very difficult to prevent the abnormalities of a work machine, and occurrence of failure.
[0006] It was originated in view of such a technical probrem, and this invention aims at offering the abnormalities / failure preperception equipment, and technique of a work machine of having enabled it to foreknow the abnormalities of work machines (especially dynamic element of a work machine), such as a construction equipment, and failure.
[0007]
[Means for Solving the Problem] For this reason, the abnormalities / failure preperception equipment of the work machine of this invention according to claim 1 A detection means to be the abnormalities / failure preperception equipment about the dynamic element of a work machine, and to detect the dynamic characteristics data of the dynamic element when inputting a stimulus into the dynamic element at the time of un-operating of the aforementioned dynamic element, A comparison means to compare the secular-change property data for which it asked beforehand with the dynamic characteristics data obtained with this detection means, It is characterized by having presumed time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison means, offering the abnormalities / a failure preperception means perform the abnormalities / failure preperception about the above-mentioned dynamic element, and being constituted based on this time.
[0008] Moreover, the abnormalities / the failure preperception technique of the work machine of this invention according to claim 2 The detection step which are the abnormalities / the failure preperception technique about the dynamic element of a work machine, inputs a stimulus into the dynamic element at the time of un-operating of the

aforementioned dynamic element, and detects the dynamic characteristics data of a dynamic element, The comparison step which compares the secular-change property data for which it asked beforehand with the dynamic characteristics data obtained at this detection step, It is characterized by having presumed time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison step, offering the abnormalities / failure preperception step which performs the abnormalities / failure preperception about the above-mentioned dynamic element, and being constituted based on this time.

[0009] Furthermore, the abnormalities / the failure preperception technique of the work machine of this invention according to claim 3 It is the abnormalities / the failure preperception technique about the dynamic element of a work machine, and is contingent [on the aforementioned dynamic element being in non-operating state]. by the necessary time interval The detection step which inputs a stimulus into the above-mentioned dynamic element, and detects the dynamic characteristics data of the dynamic element, The storage step which memorizes the dynamic characteristics data obtained at this detection step, The comparison step which compares the secular-change property data for which it asked beforehand with the above-mentioned dynamic characteristics data memorized at this storage step, It is characterized by having presumed time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison step, offering the abnormalities / failure preperception step which performs the abnormalities / failure preperception about the above-mentioned dynamic element, and being constituted based on this time.

[0010] Moreover, the abnormalities / the failure preperception technique of the work machine of this invention according to claim 4 In technique according to claim 2 or 3, the above-mentioned detection step sets at the time of un-operating of the above-mentioned dynamic element. Input white noise into this dynamic element as a stimulus, and it is constituted so that the frequency response data at that time may be detected as the above-mentioned dynamic characteristics data. It is constituted so that the above-mentioned comparison step may compare with the above-mentioned secular-change property data the frequency response data obtained at this detection step. The above-mentioned abnormalities / failure preperception step are characterized by presuming time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison step, and being constituted based on this time, so that the abnormalities / failure preperception about the above-mentioned dynamic element may be performed.

[0011] Furthermore, the abnormalities / the failure preperception technique of the work machine of this invention according to claim 5 In technique according to claim 2 or 3, the above-mentioned detection step sets at the time of un-operating of the above-mentioned dynamic element. It is constituted so that an impulse signal may be inputted into this dynamic element and the impulse response data at that time may be detected as the above-mentioned dynamic characteristics data as a stimulus. It is constituted so that the above-mentioned comparison step may compare with the above-mentioned secular-change property data the impulse response data obtained at this detection step. The above-mentioned abnormalities / failure preperception step are characterized by presuming time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison step, and being constituted

based on this time, so that the abnormalities / failure preperception about the above-mentioned dynamic element may be performed.
[0012]
[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained using a drawing. Drawing 1 is drawing showing the hydraulic excavator as such a work machine in the 1 operation gestalt of this invention typically, and as shown in this drawing 1 , such a hydraulic excavator has become right and left to the advance orientation at this operation gestalt with the configuration that the revolving super-structure with the operation room 600 100 (construction-equipment mainframe) was formed free [rotation] in the level surface on the base carrier 500 which has infinite rail section 500A.
[0013] And the boom (arm member) 200 to which an end is connected possible [rotation] is established to this revolving super-structure 100, and the stick (arm member) 300 to which an end is connected possible [rotation] through the joint section is further formed to the boom 200. Furthermore, to a stick 300, an end is connected possible [rotation] through the joint section, a nose of cam excavates the ground, and the bucket (workplace material) 400 which can hold earth and sand in the interior is **** eclipse ******. In addition, it is the addendum of a bucket 400 which is shown with a sign 112 in drawing 1 .
[0014] Moreover, as shown in this drawing 1 , the boom oil hydraulic cylinder 120, the stick oil hydraulic cylinder 121, and the bucket oil hydraulic cylinder 122 (hereafter, there is only the boom cylinder 120 or a cylinder 120 about the boom oil hydraulic cylinder 120, there is only a stick cylinder 121 or a cylinder 121 about the stick oil hydraulic cylinder 121, and there is only the bucket hydraulic cylinder 122 or a cylinder 122 about the bucket oil hydraulic cylinder 122) are formed in this hydraulic excavator to the above-mentioned boom 200, the stick 300, and the bucket 400.
[0015] Here, when the distance between edges expands and contracts, it connects possible [rotation of other ends] to a boom 200, namely, a boom cylinder 120 is infixed between a revolving super-structure 100 and the boom 200, and it can rotate a boom 200 to a revolving super-structure 100, while an end is connected possible [rotation] to a revolving super-structure 100.
[0016] Moreover, it connects possible [rotation of other ends] to a stick 300, namely, the stick cylinder 121 is infixed between a boom 200 and the stick 300 while an end is connected possible [rotation] to a boom 200, and when the distance between edges expands and contracts, it can rotate a stick 300 to a boom 200.
[0017] Furthermore, while a bucket hydraulic cylinder 122 is connected possible [rotation of an end] to a stick 300, it connects possible [rotation of other ends] to a bucket 400, namely, is infixed between a stick 300 and the bucket 400, and when the distance between edges expands and contracts, a bucket 400 can be rotated to a stick 300. In addition, the link mechanism 130 is formed in the point of the bucket oil hydraulic cylinder 122.
[0018] Moreover, although not illustrated, the hydraulic motor which drives infinite rail section 500A on either side, respectively, and the revolution motor which carries out the revolution drive of the revolving super-structure 100 are also formed. And as shown in drawing 1 and the drawing 2 , respectively, at least, the hydraulic circuit 2 for cylinders 120-122 or the above-mentioned revolution motor 123 is formed, and as shown in

drawing 2 , a hydraulic oil tank 11, the hydraulic pump 12 driven by engine (diesel power plant) E, the control valves (method change valve of three) 13A-13D, etc. are further infixed in this hydraulic circuit 2 at the above-mentioned hydraulic excavator.

[0019] Here, a hydraulic oil tank 11 ****s a hydraulic oil, and a hydraulic pump 12 carries out regurgitation supply of the hydraulic oil in this hydraulic oil tank 11 as a predetermined pressure oil, it is constituted as a piston type variable-capacity pump here, and the control of flow of a hydraulic oil is possible by changing the amount of strokes of the piston (illustration abbreviation) prepared in the pump 12. That is, the end of the above-mentioned piston is constituted so that a cam plate (creep plate:illustration abbreviation) may be contacted, the amount of strokes of a piston is changed by changing the inclination (******) of this cam plate by ****** control unit 12a, and the flow rate of a pump 12 is changed.

[0020] Moreover, the control valves 13A-13D It is for changing the supply orientation of the hydraulic oil to cylinders 120-122 and the revolution motor 123, and controlling expansion and contraction of cylinders 120-122, and the hand of cut of the revolution motor 123. here When it changes in the orientation of arrow head B shown all over drawing 2 from a center valve position, respectively, about cylinders 120-122 If it changes in the orientation of arrow head A while a hydraulic oil is supplied to the inside room 124, a hydraulic oil is extracted from the inside room 125 and a cylinder 120 is extended While a hydraulic oil is supplied to the inside room 125, a hydraulic oil is extracted from the inside room 124, a cylinder 120 is shrunken, and the hand of cut is reversed about the revolution motor 123 according to a change of arrow head A and the orientation of B.

[0021] In addition, although each change control of each of these control valves 13A-13D is performed by the controller 1 formed in the revolving super-structure 100 Based on the operation information acquired by this controller 1 when an operator operates the boom / bucket control lever 6 in the operation room 600, and the stick / revolution control lever 8, the change control signal for control valves 13A-13D is generated. A change control signal is supplied to each control valves 13A-13D, respectively.

[0022] Furthermore, as shown in drawing 2 , return line 15A to a hydraulic oil tank 11 and the relief valve 14 which can be opened for free passage are formed in the delivery side of a hydraulic pump 12, and if the discharge pressure of a hydraulic pump 12 becomes higher than a predetermined pressure, the hydraulic oil which this relief valve 20 opens and was pressurized with the pump 12 will return to this hydraulic circuit 2 at a tank 11.

[0023] And the above-mentioned controller 1 has the function as the abnormalities/fault read-out unit of the above-mentioned hydraulic excavator (work machine), and abnormalities / failure preperception equipment, and for this reason, as shown in drawing 3 , it has the stimulus output section 21, the memory 22, the detecting element 23, the judgment section 24, the abnormalities / troubleshooting section 25, the comparator 26, and the abnormalities / failure preperception section 27, and it consists of this operation gestalt. In addition, in this drawing 3 , it is the external devices which are shown with a sign 28, such as a monitor and a printer, and it can display or print out now the diagnostic result in abnormalities / troubleshooting section 25, and the preperception result in abnormalities / failure preperception section 27.

[0024] Here, the above-mentioned stimulus output section 21 outputs the stimuli

mentioned later, such as an impulse signal and white noise, to the dynamic elements (a hydraulic pump 12, control valves 13A-13D, etc.) of a hydraulic excavator. However, this stimulus is outputted in the size of the grade which does not affect the performance of a system (hydraulic excavator), and time (for example, while the above-mentioned control levers 6 and 8 are in a center valve position and the above-mentioned dynamic element is not operating etc.).

[0025] Moreover, the memory 22 As proper domain data The I/O response data at the time of a normal operation of the above-mentioned dynamic element for which it asked beforehand (Time-response data until a time delay response data:output signal reaches 63.2% of desired value, the amount of overshoot / the amount of undershooting to an amplitude decrement response data:output signal) Secular-change property data, the secular-change property data detected at the time of the abnormalities / failure preperception processing mentioned later It memorizes, and a detecting element 23 detects the I/O response data to the above-mentioned dynamic element, and with this operation gestalt, as shown in the following item (1) and (2), it detects the data according to the property of the dynamic element for a diagnosis.

[0026] (1) When the input signal (control signal) to a dynamic element changes in step, detect the transient response data to the input signal of the output signal from the dynamic element, such as time delay response data and amplitude decrement response data of the aforementioned output signal, as the above-mentioned I/O response data.

(2) change of an input signal to a dynamic element is gently-sloping -- or -- regularity (below a variation predetermined in a variation) -- a case detects dynamic characteristics data, such as impulse response data when the above-mentioned control levers 6 and 8 are in a center valve position and input a stimulus output section 21 blank-test signal (an impulse signal or white noise) into the dynamic element at the time of un-operating of a dynamic element, or frequency response data, as the above-mentioned I/O response data

[0027] However, as shown in this item (2), control levers 6 and 8 are in a center valve position, when it is the non-operating state of a dynamic element, with this operation gestalt, it is a necessary time interval, and the dynamic characteristics data of the dynamic element are detected in time for two or more minutes by inputting a stimulus into the above-mentioned dynamic element from the stimulus output section 21. In addition, the dynamic characteristics data which do in this way and were obtained are temporarily memorized by memory 22.

[0028] Furthermore, the I/O response data [transient response data with which the above-mentioned judgment section 24 was obtained by this detecting element 23 (time delay response data, amplitude decrement response data), The proper domain data with which it corresponds in impulse response data or frequency response data] and the memory 22 are compared. The above-mentioned I/O response data are what judges whether it is within proper limits for which it asked beforehand. abnormalities / troubleshooting section 25 If the above-mentioned I/O response data are judged as there being nothing within proper limits in this judgment section 24, it will be diagnosed that the above-mentioned dynamic elements for a diagnosis are abnormalities or failure.

[0029] A comparator 26 is what compares the proper domain data (secular-change property data for which it asked beforehand) with which it corresponds in the dynamic characteristics data (impulse response data or frequency response data) obtained by the above-mentioned detecting element 23, and the memory 22. moreover, abnormalities /

failure preperception section 27 According to the comparison result in this comparator 26, time until the dynamic element for a diagnosis results in abnormalities or failure is presumed, and the abnormalities / failure preperception about the above-mentioned dynamic element are performed based on this time.

[0030] Hereafter, an operation of the controller 1 in this constituted operation gestalt is explained in full detail like ****.

(a) Abnormalities / troubleshooting ****, and here explain the abnormalities/troubleshooting of the hydraulic excavator (dynamic element) by the controller 1.

[0031] As shown in abnormalities / troubleshooting view 4 in case the signal which changes to a dynamic element in step is inputted, (a1) A controller 1 To dynamic elements, such as a hydraulic pump 12 and the control valves 13A-13D Corresponding to operation of control levers 6 and 8, the step signal 31 which is shown in drawing 5 is inputted (step A1), and the step response data (time delay response data, amplitude decrement response data) to the inputted step signal 31 are detected in a detecting element 23 (step A2).

[0032] Then, by the controller 1, it judges whether there are any above-mentioned step response data with which the judgment section 24 reads the step response data which serve as the decision criterion of a proper domain from memory 22 (step A3), and was detected by the detecting element 23 within proper limits for which it asked in memory 22 beforehand (step A4). For example, it is based on the criteria step response property 32 of the hydraulic pump 12 which is shown in drawing 5 . By the maximum, supposing data called less than 5% in the amount of overshoot / the amount of undershooting to 0.5 seconds and an output signal are memorized memory 22, the time delay of an output signal the judgment section 24 It judges with it being out of range proper about the step response property 33 which is shown with a dashed line all over drawing 5 , since the time delay of an output signal is 0.7 seconds. Since the amount of overshoot is 5% or more, the step response property 34 which is shown with an alternate long and short dash line all over drawing 5 is judged with it being out of range proper.

[0033] And if it judges that the data detected by the detecting element 23 in the judgment section 24 are out of range proper in this way, abnormalities / troubleshooting section 25 will diagnose that abnormalities or failure has occurred to the above-mentioned dynamic elements (a hydraulic pump 12, control valves 13A-13D, etc.) (from NO root of step A4 to step A5), and will output the diagnostic result to an external device 28 (step A7).

[0034] In addition, when it judges that the data detected by the detecting element 23 in the judgment section 24 are proper within the limits, it diagnoses that abnormalities / troubleshooting section 25 has the above-mentioned normal dynamic element (from YES root of step A4 to step A6), and the purport is outputted to an external device 28 (step A7).

(a2) As shown in abnormalities / troubleshooting view 6 in a case gently-sloping [change of an input signal to a dynamic element], or fixed, a controller 1 inputs stimuli, such as an impulse signal or white noise, into a hydraulic pump 12 from the stimulus output section 21 first, when control levers 6 and 8 are in a center valve position (step B1). And a controller 1 detects the response (dynamic characteristics data, such as impulse response data and frequency response data) to the inputted stimulus in a detecting element 23 (step B-2).

[0035] Then, by the controller 1, it judges whether there are any above-mentioned dynamic characteristics data with which the judgment section 24 reads the dynamic characteristics data which serve as the decision criterion of a proper domain from memory 22 (step B3), and was detected by the detecting element 23 within proper limits for which it asked in memory 22 beforehand (step B4). For example, white noise is inputted into a hydraulic pump 12 as the above-mentioned stimulus. When data called within the limits of about 1.5-2.5Hz in a frequency in case the phase of peak gain or an output signal is 90 degrees based on the criteria dynamic characteristics 35 in BODE diagram which is shown in drawing 7 shall be memorized by memory 22 as proper domain data, the judgment section 24 The dynamic characteristics 36 which is shown with a dashed line all over drawing 7 is judged with it being proper within the limits, since the frequency at the time of peak gain (90 phases) is about 1.6Hz. Since the frequency at the time of peak gain (90 phases) is smaller than 1.5Hz about the dynamic characteristics 37 which is shown with an alternate long and short dash line all over drawing 7 , it judges with it being out of range proper.
[0036] And it judges that the data detected by the detecting element 23 in the judgment section 24 are out of range proper, and abnormalities / troubleshooting section 25 diagnoses that abnormalities or failure has occurred in the hydraulic pump 12 (from NO root of step B4 to step B5), and a case outputs the diagnostic result to an external device 28 (step B7). On the other hand, when it judges that the data detected by the detecting element 23 in the judgment section 24 are proper within the limits, abnormalities / troubleshooting section 25 diagnoses that the hydraulic pump 12 is operating normally (from YES root of step B4 to step B6), and the purport is outputted to an external device 28 (step B7).
[0037] According to the controller (the abnormalities/fault read-out unit of a work machine) 1 of this operation gestalt, as mentioned above The I/O response data to dynamic elements, such as the hydraulic pump 12 of a hydraulic excavator and the control valves 13A-13D, are detected. If the I/O response data does not exist within proper limits for which it asked beforehand, since it will diagnose that the above-mentioned dynamic elements are abnormalities or failure the former -- like -- an operation of a dynamic element -- it is not necessary to change a proper domain, and according to the operation conditions of the size of a variation rate, or a dynamic element, always, correctly, the abnormalities of a hydraulic excavator and failure can be recognized and suitable measures can be taken to the abnormalities and failure
[0038] (b) Explain in abnormalities / failure preperception, next the following, referring to the flow chart (steps C1-C7) shown in drawing 8 about the abnormalities / failure preperception of the hydraulic excavator (dynamic element) by the controller 1. As shown in drawing 8 , first, a controller 1 has control levers 6 and 8 in a center valve position, when it is the non-operating state of a dynamic element, white noise is inputted into a hydraulic pump 12 as a stimulus from the stimulus output section 21 (step C1), and a detecting element 23 detects the dynamic characteristics data-(for example, frequency of frequency response data:primary resonance point) of a hydraulic pump 12 (step C2).
[0039] In addition, at this time, a condition [a controller 1 having a dynamic element in non-operating state as mentioned above], it is a necessary time interval (every other [for example,] hour), the above-mentioned stimulus is inputted into a hydraulic pump 12, and the data which might be detected in the frequency response data of a hydraulic pump for

two or more minutes are memorized in memory 22 (step C3). And a controller 1 reads the secular-change property data for which it asked beforehand from memory 22 by the comparator 26 (step C4). A comparator 26 compares the secular-change property which the frequency response data detected like this secular-change property data and **** for two or more minutes make (step C5), and it responds to the comparison result. by abnormalities / failure preperception section 27 Time until a hydraulic pump 12 results in abnormalities or failure is presumed, and the abnormalities / failure preperception about a hydraulic pump 12 are performed based on this time (step C6).

[0040] For example, the criteria secular-change property of the normal hydraulic pump 12 for which it asked beforehand shows as a solid line (sign 38 reference) all over drawing 9 , and presupposes that the frequency of 1.5-2.5Hz was the proper domain of the frequency response of a hydraulic pump 12. In this case, a comparator 26 compares the secular-change property 38 (for example, inclination of the property 38 in a certain time) shown in this drawing 9 with the inclination when tying the frequency response data for two or more minutes detected by the detecting element 23.

[0041] And as a dashed line (sign 39 reference) shows during the result 9 of this comparison, for example, drawing When the inclination when tying the frequency response data for two or more minutes detected by the detecting element 23 is unusually larger than the inclination of the secular-change property 38, abnormalities / failure preperception section 27 It judges that time until the frequency response of a hydraulic pump 12 separates from the above-mentioned proper domain is very short, and if abnormalities and failure will arise at the stage when it is earlier than the normal hydraulic pump 12, abnormalities/failure of a hydraulic pump 12 will be foreknown.

[0042] In addition, as shown in drawing 8 , these abnormality / failure preperception results (for example, time until a hydraulic pump 12 results in abnormalities/failure etc.) are outputted to an external device 28 (step C7). As mentioned above, according to the controller (the abnormalities / failure preperception equipment of a work machine) 1 of this operation gestalt Compare the criteria secular-change property 38 of having detected the frequency characteristic 39 of a hydraulic pump 12, and having asked for it beforehand with the obtained frequency characteristic 39, and time until a hydraulic pump 12 results in abnormalities or failure is presumed according to the comparison result. Since the abnormalities / failure preperception about a hydraulic pump 12 are performed based on this time, it can recognize very easily how much [after] a hydraulic pump 12 has.

[0043] Therefore, it can enable it to prevent that abnormalities and failure occur in a hydraulic pump 12, and the use luminous efficacy of a hydraulic excavator can be raised sharply. Moreover, useless exchange, a useless repair, etc. to a hydraulic pump 12 can be cut down sharply, and the use luminous efficacy of hydraulic-pump 12 the very thing can also be raised sharply. In addition, although white noise is inputted into a hydraulic pump 12 and the frequency response characteristic at that time is detected as dynamic characteristics data as a stimulus in the abnormalities / failure preperception processing mentioned above, an impulse signal is inputted and it may be made to detect the impulse response data at that time as dynamic characteristics data. In this case, a comparator 26 comes to compare the secular-change property data for which it asked beforehand with the obtained impulse response data.

[0044] Moreover, although the hydraulic pump 12 was made into the example in the

abnormalities / failure preperception processing mentioned above as a dynamic element which inputs a stimulus, it is possible for control levers 6 and 8 to be in a center valve position, and to perform abnormalities / failure preperception similarly about other dynamic elements at least, if the dynamic element of a hydraulic excavator is non-operating state, and the same operation effect as the above can be acquired.

[0045] Furthermore, although the operation gestalt mentioned above explains the case where this invention is applied to a hydraulic excavator, this invention is not limited to this, begins construction equipments, such as a tractor, a loader, and a bulldozer, if it is a work machine which has a dynamic element at least, is applied similarly and, in the case of which, can acquire the same operation effect as ****.

[0046] And this invention is not limited to the operation gestalt mentioned above, in the domain which does not deviate from the meaning of this invention, can deform variously and can be carried out.

[0047]

[Effect of the Invention] As explained in full detail above, according to the abnormalities / failure preperception equipment, and technique of a work machine of this invention Compare the secular-change property data which detected the dynamic characteristics data of a dynamic element and asked for them beforehand with the obtained dynamic characteristics data, and time until a dynamic element results in abnormalities or failure is presumed according to the comparison result. Since the abnormalities / failure preperception about the dynamic element are performed based on this time, it can recognize very easily how much [after] a dynamic element has. Therefore, it can enable it to prevent that abnormalities and failure occur to a dynamic element, and the use luminous efficacy of a work machine can be raised sharply. Moreover, useless exchange, a useless repair, etc. to a dynamic element can be cut down sharply, and the use luminous efficacy of the dynamic element [itself] can also be raised sharply.

TECHNICAL FIELD

[The technical field to which invention belongs] Especially this invention is used for foreknowing the abnormalities of construction equipments, such as a hydraulic excavator and a bulldozer, and failure about the abnormalities / failure preperception equipment, and technique of a work machine, and relates to abnormalities / suitable failure preperception equipment, and suitable technique.

PRIOR ART

[Description of the Prior Art] Drawing 10 is a ** type view showing an example of the hydraulic excavator as a common work machine, and as shown in this drawing 10 , usually, the hydraulic excavator has offered the revolving super-structure 100 with

operation room (cabin) 600 on the base carrier 500 which has infinite rail section 500A, and serves as the configuration of having equipped the joint formula arm device which becomes this revolving super-structure 100 from a boom 200, the stick 300, and the bucket 400 further.

[0003] And while this hydraulic excavator is equipped with the oil hydraulic cylinder 122 for the oil hydraulic cylinder 121 for the oil hydraulic cylinder 120 for a boom 200, and the stick 300, and the bucket 400 The hydraulic circuit for each of these oil hydraulic cylinders 120-122 (illustration abbreviation) is prepared at least. By carrying out electronics control of the flow rate of the hydraulic pump in this hydraulic circuit, or the control valve the oil hydraulic cylinder 120 - for 122 according to operation (operation of the control lever in a cabin 600) of an operator, and changing suitably the amount of supply (oil pressure) of the hydraulic oil to oil hydraulic cylinders 120-122 expansion and contraction of oil hydraulic cylinders 120-122 -- a variation rate -- an amount changes and a boom 200, the stick 300, and the bucket 400 drive, respectively

[0004] By the way, since, as for such a construction equipment, a job site, a calamity restoration site, etc. are usually begun and it is used in many cases in the very severe status, the suitable treatment needs to be performed to the abnormalities and failure. Then, a sensor is conventionally attached in parts (dynamic element) for a right hand side, such as the above-mentioned hydraulic pump, and a control valve, the cylinders 120-122, and the abnormalities of a construction equipment and a diagnosis of failure are performed by comparing and judging whether the electric signal (henceforth a sensor signal) acquired by the sensor is the proper value calculated beforehand.

EFFECT OF THE INVENTION

[Effect of the Invention] As explained in full detail above, according to the abnormalities / failure preperception equipment, and technique of a work machine of this invention Compare the secular-change property data which detected the dynamic characteristics data of a dynamic element and asked for them beforehand with the obtained dynamic characteristics data, and time until a dynamic element results in abnormalities or failure is presumed according to the comparison result. Since the abnormalities / failure preperception about the dynamic element are performed based on this time, it can recognize very easily how much [after] a dynamic element has. Therefore, it can enable it to prevent that abnormalities and failure occur to a dynamic element, and the use luminous efficacy of a work machine can be raised sharply. Moreover, useless exchange, a useless repair, etc. to a dynamic element can be cut down sharply, and the use luminous efficacy of the dynamic element [itself] can also be raised sharply.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, it is almost impossible they to perform the abnormalities / failure preperception that probably abnormalities and failure will arise to a dynamic element, in what after term by the conventional troubleshooting technique, even if it can diagnose the abnormalities in the present condition of the dynamic element of a construction equipment (work machine) and failure, and it is very difficult to prevent the abnormalities of a work machine, and occurrence of failure.
[0006] It was originated in view of such a technical probrem, and this invention aims at offering the abnormalities / failure preperception equipment, and technique of a work machine of having enabled it to foreknow the abnormalities of work machines (especially dynamic element of a work machine), such as a construction equipment, and failure.

MEANS

[Means for Solving the Problem] For this reason, the abnormalities / failure preperception equipment of the work machine of this invention according to claim 1 A detection means to be the abnormalities / failure preperception equipment about the dynamic element of a work machine, and to detect the dynamic characteristics data of the dynamic element when inputting a stimulus into the dynamic element at the time of un-operating of the aforementioned dynamic element, A comparison means to compare the secular-change property data for which it asked beforehand with the dynamic characteristics data obtained with this detection means, It is characterized by having presumed time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison means, offering the abnormalities / a failure preperception means perform the abnormalities / failure preperception about the above-mentioned dynamic element, and being constituted based on this time.
[0008] Moreover, the abnormalities / the failure preperception technique of the work machine of this invention according to claim 2 The detection step which are the abnormalities / the failure preperception technique about the dynamic element of a work machine, inputs a stimulus into the dynamic element at the time of un-operating of the aforementioned dynamic element, and detects the dynamic characteristics data of a dynamic element, The comparison step which compares the secular-change property data for which it asked beforehand with the dynamic characteristics data obtained at this detection step, It is characterized by having presumed time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison step, offering the abnormalities / failure preperception step which performs the abnormalities / failure preperception about the above-mentioned dynamic element, and being constituted based on this time.
[0009] Furthermore, the abnormalities / the failure preperception technique of the work machine of this invention according to claim 3 It is the abnormalities / the failure

preperception technique about the dynamic element of a work machine, and is contingent [on the aforementioned dynamic element being in non-operating state]. by the necessary time interval The detection step which inputs a stimulus into the above-mentioned dynamic element, and detects the dynamic characteristics data of the dynamic element, The storage step which memorizes the dynamic characteristics data obtained at this detection step, The comparison step which compares the secular-change property data for which it asked beforehand with the above-mentioned dynamic characteristics data memorized at this storage step, It is characterized by having presumed time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison step, offering the abnormalities / failure preperception step which performs the abnormalities / failure preperception about the above-mentioned dynamic element, and being constituted based on this time.

[0010] Moreover, the abnormalities / the failure preperception technique of the work machine of this invention according to claim 4 In technique according to claim 2 or 3, the above-mentioned detection step sets at the time of un-operating of the above-mentioned dynamic element. Input white noise into this dynamic element as a stimulus, and it is constituted so that the frequency response data at that time may be detected as the above-mentioned dynamic characteristics data. It is constituted so that the above-mentioned comparison step may compare with the above-mentioned secular-change property data the frequency response data obtained at this detection step. The above-mentioned abnormalities / failure preperception step are characterized by presuming time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison step, and being constituted based on this time, so that the abnormalities / failure preperception about the above-mentioned dynamic element may be performed.

[0011] Furthermore, the abnormalities / the failure preperception technique of the work machine of this invention according to claim 5 In technique according to claim 2 or 3, the above-mentioned detection step sets at the time of un-operating of the above-mentioned dynamic element. It is constituted so that an impulse signal may be inputted into this dynamic element and the impulse response data at that time may be detected as the above-mentioned dynamic characteristics data as a stimulus. It is constituted so that the above-mentioned comparison step may compare with the above-mentioned secular-change property data the impulse response data obtained at this detection step. The above-mentioned abnormalities / failure preperception step are characterized by presuming time until the above-mentioned dynamic element results in abnormalities or failure according to the comparison result in this comparison step, and being constituted based on this time, so that the abnormalities / failure preperception about the above-mentioned dynamic element may be performed.

[0012]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained using a drawing. Drawing 1 is drawing showing the hydraulic excavator as such a work machine in the 1 operation gestalt of this invention typically, and as shown in this drawing 1 , such a hydraulic excavator has become right and left to the advance orientation at this operation gestalt with the configuration that the revolving super-structure with the operation room 600 100 (construction-equipment mainframe) was formed free [rotation] in the level surface on the base carrier 500 which has infinite rail

section 500A.
[0013] And the boom (arm member) 200 to which an end is connected possible [rotation] is established to this revolving super-structure 100, and the stick (arm member) 300 to which an end is connected possible [rotation] through the joint section is further formed to the boom 200. Furthermore, to a stick 300, an end is connected possible [rotation] through the joint section, a nose of cam excavates the ground, and the bucket (workplace material) 400 which can hold earth and sand in the interior is **** eclipse ******. In addition, it is the addendum of a bucket 400 which is shown with a sign 112 in drawing 1 .

[0014] Moreover, as shown in this drawing 1 , the boom oil hydraulic cylinder 120, the stick oil hydraulic cylinder 121, and the bucket oil hydraulic cylinder 122 (hereafter, there is only the boom cylinder 120 or a cylinder 120 about the boom oil hydraulic cylinder 120, there is only a stick cylinder 121 or a cylinder 121 about the stick oil hydraulic cylinder 121, and there is only the bucket hydraulic cylinder 122 or a cylinder 122 about the bucket oil hydraulic cylinder 122) are formed in this hydraulic excavator to the above-mentioned boom 200, the stick 300, and the bucket 400.
[0015] Here, when the distance between edges expands and contracts, it connects possible [rotation of other ends] to a boom 200, namely, a boom cylinder 120 is infixed between a revolving super-structure 100 and the boom 200, and it can rotate a boom 200 to a revolving super-structure 100, while an end is connected possible [rotation] to a revolving super-structure 100.
[0016] Moreover, it connects possible [rotation of other ends] to a stick 300, namely, the stick cylinder 121 is infixed between a boom 200 and the stick 300 while an end is connected possible [rotation] to a boom 200, and when the distance between edges expands and contracts, it can rotate a stick 300 to a boom 200.
[0017] Furthermore, while a bucket hydraulic cylinder 122 is connected possible [rotation of an end] to a stick 300, it connects possible [rotation of other ends] to a bucket 400, namely, is infixed between a stick 300 and the bucket 400, and when the distance between edges expands and contracts, a bucket 400 can be rotated to a stick 300. In addition, the link mechanism 130 is formed in the point of the bucket oil hydraulic cylinder 122.
[0018] Moreover, although not illustrated, the hydraulic motor which drives infinite rail section 500A on either side, respectively, and the revolution motor which carries out the revolution drive of the revolving super-structure 100 are also formed. And as shown in drawing 1 and the drawing 2 , respectively, at least, the hydraulic circuit 2 for cylinders 120-122 or the above-mentioned revolution motor 123 is formed, and as shown in drawing 2 , a hydraulic oil tank 11, the hydraulic pump 12 driven by engine (diesel power plant) E, the control valves (method change valve of three) 13A-13D, etc. are further infixed in this hydraulic circuit 2 at the above-mentioned hydraulic excavator.
[0019] Here, a hydraulic oil tank 11 ****s a hydraulic oil, and a hydraulic pump 12 carries out regurgitation supply of the hydraulic oil in this hydraulic oil tank 11 as a predetermined pressure oil, it is constituted as a piston type variable-capacity pump here, and the control of flow of a hydraulic oil is possible by changing the amount of strokes of the piston (illustration abbreviation) prepared in the pump 12. That is, the end of the above-mentioned piston is constituted so that a cam plate (creep plate:illustration abbreviation) may be contacted, the amount of strokes of a piston is changed by changing

the inclination (******) of this cam plate by ****** control unit 12a, and the flow rate of a pump 12 is changed.
[0020] Moreover, the control valves 13A-13D It is for changing the supply orientation of the hydraulic oil to cylinders 120-122 and the revolution motor 123, and controlling expansion and contraction of cylinders 120-122, and the hand of cut of the revolution motor 123. here When it changes in the orientation of arrow head B shown all over drawing 2 from a center valve position, respectively, about cylinders 120-122 If it changes in the orientation of arrow head A while a hydraulic oil is supplied to the inside room 124, a hydraulic oil is extracted from the inside room 125 and a cylinder 120 is extended While a hydraulic oil is supplied to the inside room 125, a hydraulic oil is extracted from the inside room 124, a cylinder 120 is shrunken, and the hand of cut is reversed about the revolution motor 123 according to a change of arrow head A and the orientation of B.
[0021] In addition, although each change control of each of these control valves 13A-13D is performed by the controller 1 formed in the revolving super-structure 100 Based on the operation information acquired by this controller 1 when an operator operates the boom / bucket control lever 6 in the operation room 600, and the stick / revolution control lever 8, the change control signal for control valves 13A-13D is generated. A change control signal is supplied to each control valves 13A-13D, respectively.
[0022] Furthermore, as shown in drawing 2 , return line 15A to a hydraulic oil tank 11 and the relief valve 14 which can be opened for free passage are formed in the delivery side of a hydraulic pump 12, and if the discharge pressure of a hydraulic pump 12 becomes higher than a predetermined pressure, the hydraulic oil which this relief valve 20 opens and was pressurized with the pump 12 will return to this hydraulic circuit 2 at a tank 11.
[0023] And the above-mentioned controller 1 has the function as the abnormalities/fault read-out unit of the above-mentioned hydraulic excavator (work machine), and abnormalities / failure preperception equipment, and for this reason, as shown in drawing 3 , it has the stimulus output section 21, the memory 22, the detecting element 23, the judgment section 24, the abnormalities / troubleshooting section 25, the comparator 26, and the abnormalities / failure preperception section 27, and it consists of this operation gestalt. In addition, in this drawing 3 , it is the external devices which are shown with a sign 28, such as a monitor and a printer, and it can display or print out now the diagnostic result in abnormalities / troubleshooting section 25, and the preperception result in abnormalities / failure preperception section 27.
[0024] Here, the above-mentioned stimulus output section 21 outputs the stimuli mentioned later, such as an impulse signal and white noise, to the dynamic elements (a hydraulic pump 12, control valves 13A-13D, etc.) of a hydraulic excavator. However, this stimulus is outputted in the size of the grade which does not affect the performance of a system (hydraulic excavator), and time (for example, while the above-mentioned control levers 6 and 8 are in a center valve position and the above-mentioned dynamic element is not operating etc.).
[0025] Moreover, the memory 22 As proper domain data The I/O response data at the time of a normal operation of the above-mentioned dynamic element for which it asked beforehand (Time-response data until a time delay response data:output signal reaches 63.2% of desired value, the amount of overshoot / the amount of undershooting to an

amplitude decrement response data:output signal) Secular-change property data, the secular-change property data detected at the time of the abnormalities / failure preperception processing mentioned later It memorizes, and a detecting element 23 detects the I/O response data to the above-mentioned dynamic element, and with this operation gestalt, as shown in the following item (1) and (2), it detects the data according to the property of the dynamic element for a diagnosis.

[0026] (1) When the input signal (control signal) to a dynamic element changes in step, detect the transient response data to the input signal of the output signal from the dynamic element, such as time delay response data and amplitude decrement response data of the aforementioned output signal, as the above-mentioned I/O response data. (2) change of an input signal to a dynamic element is gently-sloping -- or -- regularity (below a variation predetermined in a variation) -- a case detects dynamic characteristics data, such as impulse response data when the above-mentioned control levers 6 and 8 are in a center valve position and input a stimulus output section 21 blank-test signal (an impulse signal or white noise) into the dynamic element at the time of un-operating of a dynamic element, or frequency response data, as the above-mentioned I/O response data

[0027] However, as shown in this item (2), control levers 6 and 8 are in a center valve position, when it is the non-operating state of a dynamic element, with this operation gestalt, it is a necessary time interval, and the dynamic characteristics data of the dynamic element are detected in time for two or more minutes by inputting a stimulus into the above-mentioned dynamic element from the stimulus output section 21. In addition, the dynamic characteristics data which do in this way and were obtained are temporarily memorized by memory 22.

[0028] Furthermore, the I/O response data [transient response data with which the above-mentioned judgment section 24 was obtained by this detecting element 23 (time delay response data, amplitude decrement response data), The proper domain data with which it corresponds in impulse response data or frequency response data] and the memory 22 are compared. The above-mentioned I/O response data are what judges whether it is within proper limits for which it asked beforehand. abnormalities / troubleshooting section 25 If the above-mentioned I/O response data are judged as there being nothing within proper limits in this judgment section 24, it will be diagnosed that the above-mentioned dynamic elements for a diagnosis are abnormalities or failure.

[0029] A comparator 26 is what compares the proper domain data (secular-change property data for which it asked beforehand) with which it corresponds in the dynamic characteristics data (impulse response data or frequency response data) obtained by the above-mentioned detecting element 23, and the memory 22. moreover, abnormalities / failure preperception section 27 According to the comparison result in this comparator 26, time until the dynamic element for a diagnosis results in abnormalities or failure is presumed, and the abnormalities / failure preperception about the above-mentioned dynamic element are performed based on this time.

[0030] Hereafter, an operation of the controller 1 in this constituted operation gestalt is explained in full detail like ****.

(a) Abnormalities / troubleshooting ****, and here explain the abnormalities/troubleshooting of the hydraulic excavator (dynamic element) by the controller 1.

[0031] As shown in abnormalities / troubleshooting view 4 in case the signal which

changes to a dynamic element in step is inputted, (a1) A controller 1 To dynamic elements, such as a hydraulic pump 12 and the control valves 13A-13D Corresponding to operation of control levers 6 and 8, the step signal 31 which is shown in drawing 5 is inputted (step A1), and the step response data (time delay response data, amplitude decrement response data) to the inputted step signal 31 are detected in a detecting element 23 (step A2).

[0032] Then, by the controller 1, it judges whether there are any above-mentioned step response data with which the judgment section 24 reads the step response data which serve as the decision criterion of a proper domain from memory 22 (step A3), and was detected by the detecting element 23 within proper limits for which it asked in memory 22 beforehand (step A4). For example, it is based on the criteria step response property 32 of the hydraulic pump 12 which is shown in drawing 5 . By the maximum, supposing data called less than 5% in the amount of overshoot / the amount of undershooting to 0.5 seconds and an output signal are memorized memory 22, the time delay of an output signal the judgment section 24 It judges with it being out of range proper about the step response property 33 which is shown with a dashed line all over drawing 5 , since the time delay of an output signal is 0.7 seconds. Since the amount of overshoot is 5% or more, the step response property 34 which is shown with an alternate long and short dash line all over drawing 5 is judged with it being out of range proper.

[0033] And if it judges that the data detected by the detecting element 23 in the judgment section 24 are out of range proper in this way, abnormalities / troubleshooting section 25 will diagnose that abnormalities or failure has occurred to the above-mentioned dynamic elements (a hydraulic pump 12, control valves 13A-13D, etc.) (from NO root of step A4 to step A5), and will output the diagnostic result to an external device 28 (step A7).

[0034] In addition, when it judges that the data detected by the detecting element 23 in the judgment section 24 are proper within the limits, it diagnoses that abnormalities / troubleshooting section 25 has the above-mentioned normal dynamic element (from YES root of step A4 to step A6), and the purport is outputted to an external device 28 (step A7).

(a2) As shown in abnormalities / troubleshooting view 6 in a case gently-sloping [change of an input signal to a dynamic element], or fixed, a controller 1 inputs stimuli, such as an impulse signal or white noise, into a hydraulic pump 12 from the stimulus output section 21 first, when control levers 6 and 8 are in a center valve position (step B1). And a controller 1 detects the response (dynamic characteristics data, such as impulse response data and frequency response data) to the inputted stimulus in a detecting element 23 (step B-2).

[0035] Then, by the controller 1, it judges whether there are any above-mentioned dynamic characteristics data with which the judgment section 24 reads the dynamic characteristics data which serve as the decision criterion of a proper domain from memory 22 (step B3), and was detected by the detecting element 23 within proper limits for which it asked in memory 22 beforehand (step B4). For example, white noise is inputted into a hydraulic pump 12 as the above-mentioned stimulus. When data called within the limits of about 1.5-2.5Hz in a frequency in case the phase of peak gain or an output signal is 90 degrees based on the criteria dynamic characteristics 35 in BODE diagram which is shown in drawing 7 shall be memorized by memory 22 as proper domain data, the judgment section 24 The dynamic characteristics 36 which is shown

with a dashed line all over drawing 7 is judged with it being proper within the limits, since the frequency at the time of peak gain (90 phases) is about 1.6Hz. Since the frequency at the time of peak gain (90 phases) is smaller than 1.5Hz about the dynamic characteristics 37 which is shown with an alternate long and short dash line all over drawing 7 , it judges with it being out of range proper.

[0036] And it judges that the data detected by the detecting element 23 in the judgment section 24 are out of range proper, and abnormalities / troubleshooting section 25 diagnoses that abnormalities or failure has occurred in the hydraulic pump 12 (from NO root of step B4 to step B5), and a case outputs the diagnostic result to an external device 28 (step B7). On the other hand, when it judges that the data detected by the detecting element 23 in the judgment section 24 are proper within the limits, abnormalities / troubleshooting section 25 diagnoses that the hydraulic pump 12 is operating normally (from YES root of step B4 to step B6), and the purport is outputted to an external device 28 (step B7).

[0037] According to the controller (the abnormalities/fault read-out unit of a work machine) 1 of this operation gestalt, as mentioned above The I/O response data to dynamic elements, such as the hydraulic pump 12 of a hydraulic excavator and the control valves 13A-13D, are detected. If the I/O response data does not exist within proper limits for which it asked beforehand, since it will diagnose that the above-mentioned dynamic elements are abnormalities or failure the former -- like -- an operation of a dynamic element -- it is not necessary to change a proper domain, and according to the operation conditions of the size of a variation rate, or a dynamic element, always, correctly, the abnormalities of a hydraulic excavator and failure can be recognized and suitable measures can be taken to the abnormalities and failure

[0038] (b) Explain in abnormalities / failure preperception, next the following, referring to the flow chart (steps C1-C7) shown in drawing 8 about the abnormalities / failure preperception of the hydraulic excavator (dynamic element) by the controller 1. As shown in drawing 8 , first, a controller 1 has control levers 6 and 8 in a center valve position, when it is the non-operating state of a dynamic element, white noise is inputted into a hydraulic pump 12 as a stimulus from the stimulus output section 21 (step C1), and a detecting element 23 detects the dynamic characteristics data (for example, frequency of frequency response data:primary resonance point) of a hydraulic pump 12 (step C2).

[0039] In addition, at this time, a condition [a controller 1 having a dynamic element in non-operating state as mentioned above], it is a necessary time interval (every other [for example,] hour), the above-mentioned stimulus is inputted into a hydraulic pump 12, and the data which might be detected in the frequency response data of a hydraulic pump for two or more minutes are memorized in memory 22 (step C3). And a controller 1 reads the secular-change property data for which it asked beforehand from memory 22 by the comparator 26 (step C4). A comparator 26 compares the secular-change property which the frequency response data detected like this secular-change property data and **** for two or more minutes make (step C5), and it responds to the comparison result. by abnormalities / failure preperception section 27 Time until a hydraulic pump 12 results in abnormalities or failure is presumed, and the abnormalities / failure preperception about a hydraulic pump 12 are performed based on this time (step C6).

[0040] For example, the criteria secular-change property of the normal hydraulic pump 12 for which it asked beforehand shows as a solid line (sign 38 reference) all over

drawing 9 , and presupposes that the frequency of 1.5-2.5Hz was the proper domain of the frequency response of a hydraulic pump 12. In this case, a comparator 26 compares the secular-change property 38 (for example, inclination of the property 38 in a certain time) shown in this drawing 9 with the inclination when tying the frequency response data for two or more minutes detected by the detecting element 23.
[0041] And as a dashed line (sign 39 reference) shows during the result 9 of this comparison, for example, drawing When the inclination when tying the frequency response data for two or more minutes detected by the detecting element 23 is unusually larger than the inclination of the secular-change property 38, abnormalities / failure preperception section 27 It judges that time until the frequency response of a hydraulic pump 12 separates from the above-mentioned proper domain is very short, and if abnormalities and failure will arise at the stage when it is earlier than the normal hydraulic pump 12, abnormalities/failure of a hydraulic pump 12 will be foreknown.
[0042] In addition, as shown in drawing 8 , these abnormality / failure preperception results (for example, time until a hydraulic pump 12 results in abnormalities/failure etc.) are outputted to an external device 28 (step C7). As mentioned above, according to the controller (the abnormalities / failure preperception equipment of a work machine) 1 of this operation gestalt Compare the criteria secular-change property 38 of having detected the frequency characteristic 39 of a hydraulic pump 12, and having asked for it beforehand with the obtained frequency characteristic 39, and time until a hydraulic pump 12 results in abnormalities or failure is presumed according to the comparison result. Since the abnormalities / failure preperception about a hydraulic pump 12 are performed based on this time, it can recognize very easily how much [after] a hydraulic pump 12 has.
[0043] Therefore, it can enable it to prevent that abnormalities and failure occur in a hydraulic pump 12, and the use luminous efficacy of a hydraulic excavator can be raised sharply. Moreover, useless exchange, a useless repair, etc. to a hydraulic pump 12 can be cut down sharply, and the use luminous efficacy of hydraulic-pump 12 the very thing can also be raised sharply. In addition, although white noise is inputted into a hydraulic pump 12 and the frequency response characteristic at that time is detected as dynamic characteristics data as a stimulus in the abnormalities / failure preperception processing mentioned above, an impulse signal is inputted and it may be made to detect the impulse response data at that time as dynamic characteristics data. In this case, a comparator 26 comes to compare the secular-change property data for which it asked beforehand with the obtained impulse response data.
[0044] Moreover, although the hydraulic pump 12 was made into the example in the abnormalities / failure preperception processing mentioned above as a dynamic element which inputs a stimulus, it is possible for control levers 6 and 8 to be in a center valve position, and to perform abnormalities / failure preperception similarly about other dynamic elements at least, if the dynamic element of a hydraulic excavator is non-operating state, and the same operation effect as the above can be acquired.
[0045] Furthermore, although the operation gestalt mentioned above explains the case where this invention is applied to a hydraulic excavator, this invention is not limited to this, begins construction equipments, such as a tractor, a loader, and a bulldozer, if it is a work machine which has a dynamic element at least, is applied similarly and, in the case of which, can acquire the same operation effect as ****.

[0046] And this invention is not limited to the operation gestalt mentioned above, in the domain which does not deviate from the meaning of this invention, can deform variously and can be carried out.

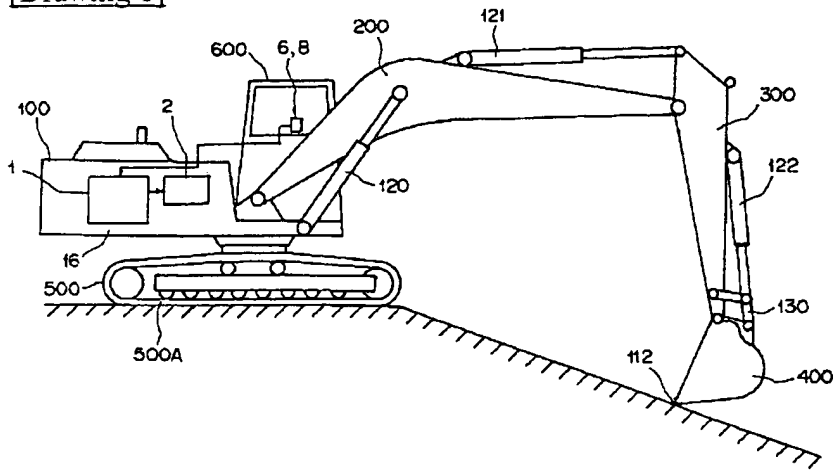
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the hydraulic excavator as such a work machine in the 1 operation gestalt of this invention typically.
[Drawing 2] It is the block diagram showing the configuration of the important section of a hydraulic circuit in the hydraulic excavator of this operation gestalt.
[Drawing 3] It is the block diagram showing the configuration of the important section of the controller in the hydraulic excavator of this operation gestalt.
[Drawing 4] It is a flow chart for explaining an operation of the controller (abnormalities/troubleshooting) in the hydraulic excavator of this operation gestalt.
[Drawing 5] It is drawing showing an example of the step response property for explaining an operation of the controller (abnormalities/troubleshooting) in the hydraulic excavator of this operation gestalt.
[Drawing 6] It is a flow chart for explaining an operation of the controller (abnormalities/troubleshooting) in the hydraulic excavator of this operation gestalt.
[Drawing 7] It is BODE diagram showing an example of the frequency response characteristic for explaining an operation of the controller (abnormalities/troubleshooting) in the hydraulic excavator of this operation gestalt.
[Drawing 8] It is a flow chart for explaining an operation of the controller (abnormalities / failure preperception) in the hydraulic excavator of this operation gestalt.
[Drawing 9] It is drawing showing an example of the frequency response characteristic for explaining an operation of the controller (abnormalities / failure preperception) in the hydraulic excavator of this operation gestalt.
[Drawing 10] It is the ** type view showing an example of the hydraulic excavator as a common work machine.
[Description of Notations]
1 Controller (Abnormalities/Fault Read-out Unit, Abnormalities / Failure Preperception Equipment)
2 Hydraulic Circuit
6 Boom / Bucket Control Lever
8 Stick / Revolution Control Lever
10 Monitor
10A Monitor panel
11 Hydraulic Oil Tank
12 Hydraulic Pump
12a ****** control unit
13A-13D Control valve (method change valve of three)

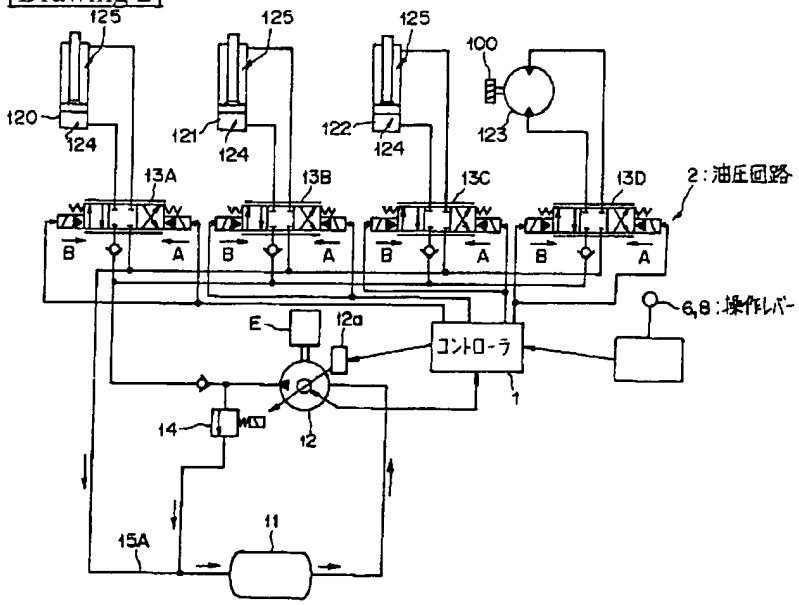
14 Relief Valve
15A Return line
21 Stimulus Output Section
22 Memory
23 Detecting Element
24 Judgment Section
25 Abnormalities / Troubleshooting Section
26 Comparator
27 Abnormalities / Failure Preperception Section
28 External Device
32 Criteria Step Response Property
33, 34 Step response property
35 Criteria Dynamic Characteristics
36, 37 Dynamic characteristics
38 Criteria Secular-Change Property
39 Secular-Change Property
100 Revolving Super-structure (Construction-Equipment Mainframe)
112 Addendum
120 Boom Oil Hydraulic Cylinder
121 Stick Oil Hydraulic Cylinder
122 Bucket Oil Hydraulic Cylinder
123 Revolution Motor
124,125 Inside room
130 Link Mechanism
200 Boom
300 Stick
400 Bucket
500 Base Carrier
500A Infinite rail section
600 Operation Room
E Engine (diesel power plant)

DRAWINGS

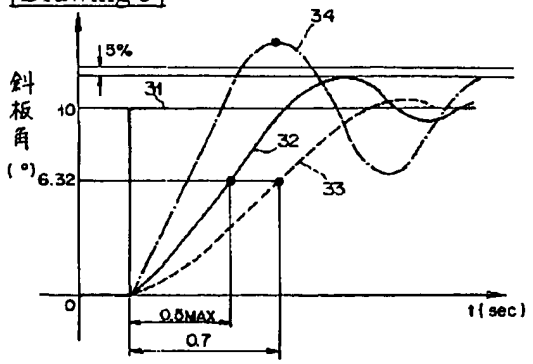
[Drawing 1]



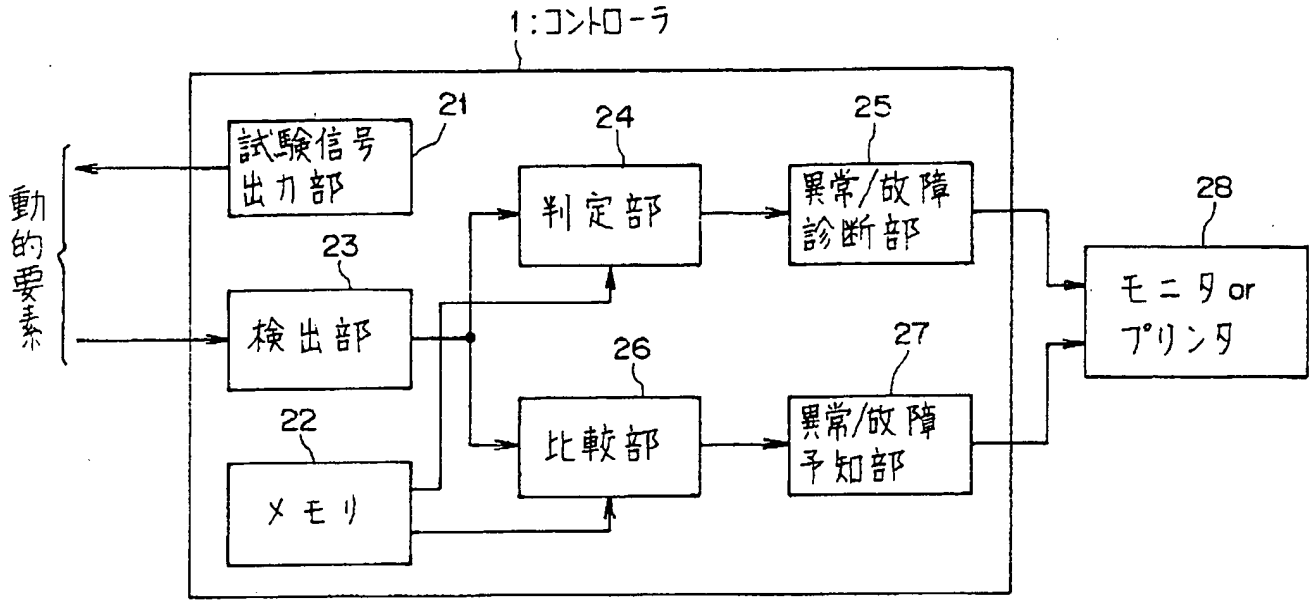
[Drawing 2]



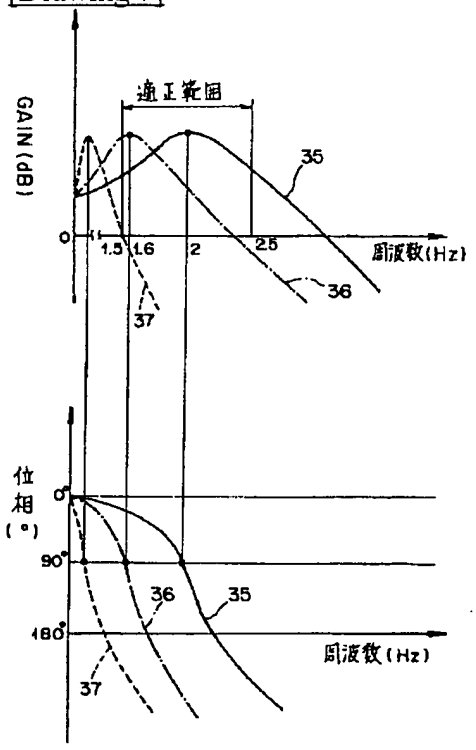
[Drawing 5]



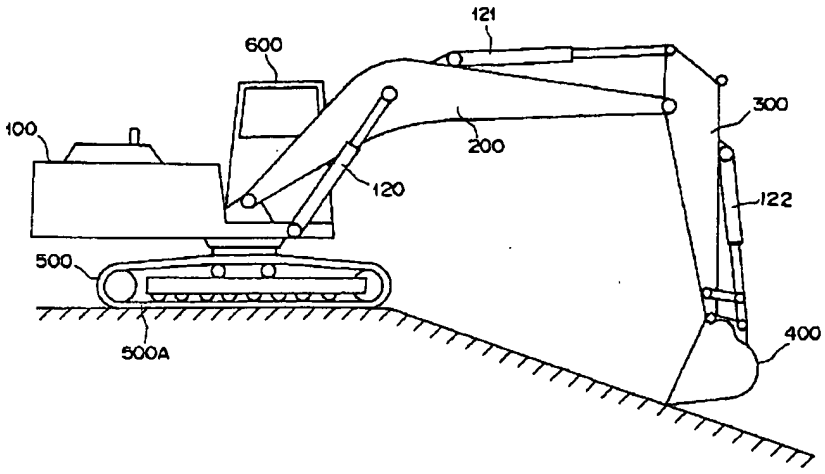
[Drawing 3]



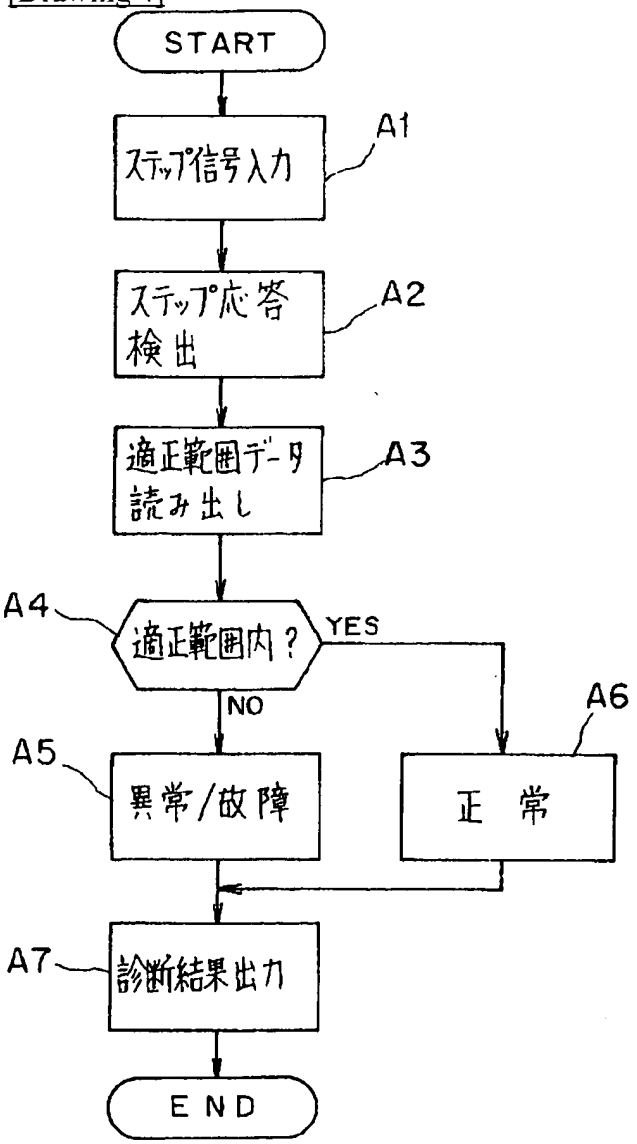
[Drawing 7]



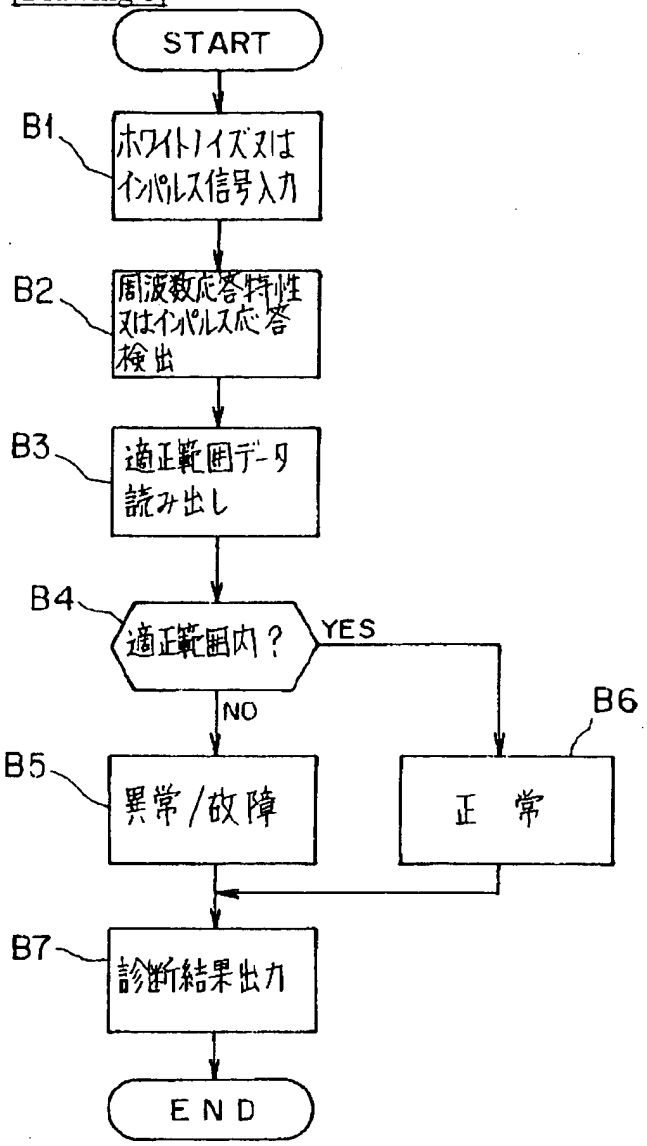
[Drawing 10]


121
600
300
100
200
120
122
500
400
500A

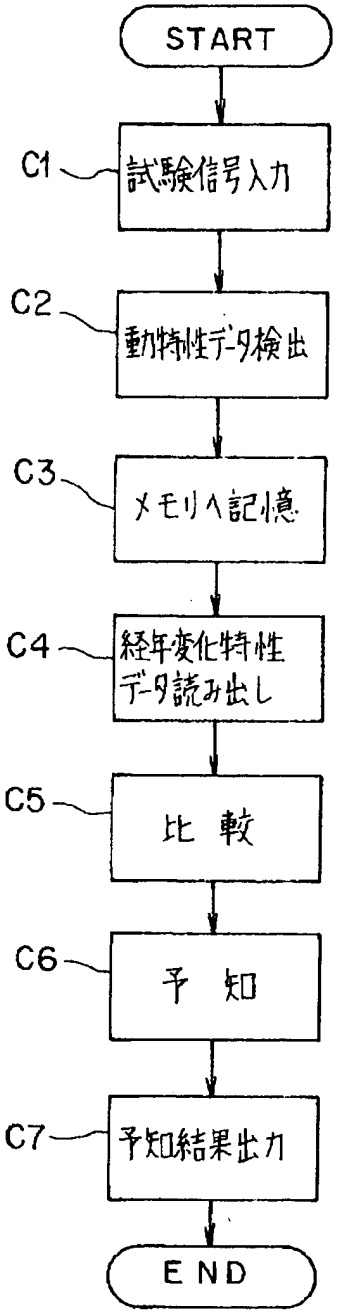
[Drawing 4]


START
ステップ信号入力
A1
ステップ応答検出
A2
適正範囲データ読み出し
A3
A4
適正範囲内？
YES
NO
A5
異常/故障
A6
正常
A7
診断結果出力
END

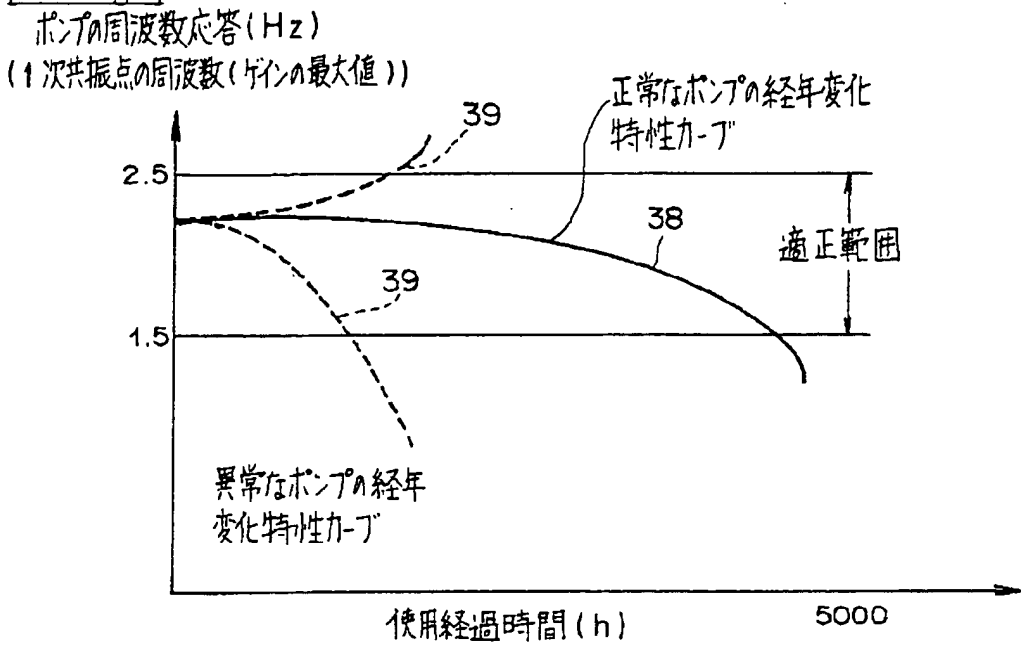
[Drawing 6]



[Drawing 8]


START
C1
試験信号入力
C2
動特性データ検出
C3
メモリへ記憶
C4
経年変化特性
データ読み出し
C5
比較
C6
予知
C7
予知結果出力
END

[Drawing 9]


ポンプの周波数応答(Hz)
(1次共振点の周波数(ゲインの最大値))
正常なポンプの経年変化
特性カーブ
39
2.5
38
適正範囲
39
1.5
異常なポンプの経年
変化特性カーブ
使用経過時間(h)
5000